

REMARKS

Claims 1-21 are present in this application. Claims 8-21 have been withdrawn. Of the elected claims, claim 1 is independent.

Claim Rejection – 35 U.S.C. § 112

Claim 2 has been rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the enablement requirement. Applicants request that the rejection be withdrawn.

The Office Action indicates that claim 2 states a limitation which is not supported by the elected Species which relates to figures 1-6. The Office Action also indicates that the limitation of claim 2 is shown in the present drawings.

Accordingly, at least as admitted in the Office Action, Applicants submit that the subject matter of claim 2 is described in the specification in such a way as to enable one skilled in the art to make and use the invention. In particular, the limitation recited in claim 2 is covered by, for example, the description of Fig. 9 on page 33 of the specification.

In addition, Applicants submit that claim 1 is generic to claim 2, and both claims cover embodiments of a semiconductor laser that are easy to produce, use low power consumption and have reduced feedback induced noise (present specification at page 12, lines 24-27).

For at least these reasons, Applicants request that the rejection be reconsidered and withdrawn.

Claim Rejection – 35 U.S.C. § 102(b)

Claim 1 is rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent 5,283,799 (Jacquet). Applicants respectfully traverse this rejection.

Embodiments of claim 1 are directed to a semiconductor laser in which at least one electrode of a first polarity (e.g., 1, 2) and an electrode of a second polarity (e.g., 5, 6) is divided to allow current to be injected independently into a light-amplifying region (e.g., 3) and a saturable absorber region (e.g., 4).

According to the present specification at page 23, by having a current injected into the light-amplifying region independently of current injected into the saturable absorber region, the hysteresis can be controlled to decrease the lasing threshold and thereby drive the laser with a lower current or adjust the amplitude of the optical output. In particular, intensity of the additional noise is appropriately adjusted and then added to the modulation current. Thus, the value of the current to be injected is changed at random around the central value of the modulation current. Subsequently, the maximum value of the modulation current and a change in intensity of the additional noise are stochastically synchronized and a temporal transition to the upper hysteresis path can occur. In order to clarify this aspect of the invention, claim 1 has been amended as follows:

“A semiconductor laser reducing feedback induced noise by an optical output modulated to arise stochastic resonance”

“at least one of said electrode of the first polarity and said electrode of the second polarity is divided to allow a current to be injected independently into said light-amplifying region and said saturable absorber region, wherein hysteresis is controlled to adjust the lasing threshold of the laser.”

Applicants submit that the cited prior art references are directed to conventional technology comparable to conventional art disclosed in the present “Background of the Invention.” Applicants submit that none of the cited references including Jacquet teach or suggest the stochastic resonance phenomenon as recited in claim 1 as amended.

Applicants request that the rejection be reconsidered and withdrawn.

Claim Rejection – 35 U.S.C. § 103(a)

Claims 3 and 5-7 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Jacquet in view of U.S. Patent 6,205,161 (Kappeler). Applicants respectfully traverse this rejection.

At least for the same reasons as above for claim 1, Applicants submit that claims 3 and 5-7 are patentable as well.

Claim 3 is directed to a further feature that the current to be injected is generated by superimposing a noise current on a modulation current, and the intensity of the modulation current and the intensity of the noise current are adjusted with respect to each other so as to allow the modulation optical output to have a large amplitude and achieve an effect of reducing the

feedback-induced noise (based on the relationship between injection current and optical output shown in Fig. 3). In other words, the maximum value of the modulation current and the additional noise current are synchronized resulting in a modulation current that attains its maximum, transition to the upper hysteresis path, and an increase in output amplitude (paragraph bridging pages 22-23). In addition, since a current is injected into the saturable absorber region independently of the current injected into light-amplifying region, the hysteresis can be controlled to decrease the lasing threshold and thereby drive the laser with a lower current (page 23, lines 4-13).

The Office Action relies on Kappeler for teaching the features of claim 3. In particular, the Office Action alleges that Kappeler teaches operation of a laser diode wherein a modulated current signal superimposed with a noise current having a random intensity change is used to drive the device (referring to sections at col. 8, lines 38, 39, col. 8, line 66, to col. 9, line 5, and col. 9, line 60-65).

The sections in Kappeler disclose superimposition circuitry to superimpose a noise signal over a modulated signal. The circuitry constructs additively a combined signal that is provided to the laser diode. The noise signal added to the modulated signal is provided to stabilize the laser diode against mode hopping, specifically when reflections from a surface interfere with the diode (col. 1, lines 50-56). Mode hopping is when a laser diode shifts spontaneously from one mode to another at specific ranges of intensity (col. 1, lines 28-30). In particular, mode hopping can be prevented by establishing as many different modes as possible inside a laser diode (col. 1, line

66, to col. 2, line 1). The noise signal is a random broad-band signal causing a number of modes to be generated inside the diode (col. 8, lines 38-40).

With respect to claim 3, although Kappeler does appear to teach current generated by superposing a noise current on a modulation current, it does not appear that the superposed signal includes adjustment of the noise current in order to generate an optical output having a large amplitude. In particular, Kappeler's device does not produce a modulated optical output in a bistable state. Since Kappeler's device does not produce a modulated output that is bistable, there is no adjustment in the hysteresis path of Kappeler's device. In other words, it appears that Kappeler's device is directed to a different operation and effect than the present invention.

Thus, Applicants submit that Kappeler fails to teach or suggest at least the claimed, "the intensity of said modulation current and the intensity of said noise current are adjusted with respect to each other so as to allow the modulation optical output to have a large amplitude and achieve an effect of reducing the feedback-induced noise."

For at least these additional reasons, Applicants request that the rejection be reconsidered and withdrawn.

Claim Rejection – 35 U.S.C. § 103(a)

Claim 4 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Jacquet and Kappeler, in view of U.S. Patent 5,394,260 (Suzuki). Applicants respectfully traverse this rejection.

At least for the same reasons as above for claims 1 and 3, Applicants submit that claim 4 is patentable as well.

Claim 4 recites an additional feature that the modulation current preferably has a rectangular wave.

The Office Action relies on Suzuki for teaching the feature of claim 4 of a modulation current having a rectangular wave. Suzuki discloses an electro-absorption type optical modulator 2 driven by a rectangular voltage (Embodiment 2, col. 7, line 66, to col. 8, line 11). The optical modulator is part of an optical pulse generator (Fig. 2A). The pulsed output of the optical pulse generator is shown in Fig. 2B.

It can be seen that Suzuki teaches application of a rectangular voltage to a pulse generator in order to produce a pulse signal having short optical pulses. Suzuki does not teach a modulation current that is adjusted to have a large amplitude and to achieve an effect of reducing feedback-induced noise, as required by claim 4 in the context of claim 3.

Thus, Applicants request that the rejection be reconsidered and withdrawn.

Conclusion

In view of the above amendment, Applicants believe the pending application is in condition for allowance.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Robert W. Downs (Reg. No.

48,222) at the telephone number of (703) 205-8000, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

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Respectfully submitted,

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